DOCUMENT RESUME

ED 074 895 HE 003 854

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TITLE	Rates of Return on University Education With Economies of Scale.
INSTITUTION	Bradford Univ. (England).
PUB DATE	[72]
NOTE	12p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Cost Effectiveness; *Educational Benefits; Educational Planning; *Higher Education; *International Education
IDENTIFIERS	*Great Britain

ABSTRACT

The authors of the present document had as their purpose to determine somewhat the worth of a college education. In order to do this, they show (1) how much a university education costs; (2) what the rates of return on this cost are and who the beneficiary of these returns is; (3) how costs might be reduced with expanded enrollment; and (4) how rates of return on investment in university education would be thus increased. The discussion supports and promotes the theory that university education in Great Britain should be expanded. (Author/HS)

ED 074895

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RATES OF RETURN ON UNIVERSITY EDUCATION WITH ECONOMIES OF SCALE

By Anthony Bottomley and John Dunworth*

In this paper we will try to show (1) how much university education costs (2) what the rates of return on it are and who gets them+, (3) how costs might be reduced with expanded enrolment, and (4) how rates of return on investment in university education would be thus increased. The discussion will throw light on the question of whether or not the universities should be allowed to expand.

1. How Much Does a University Education Cost?

Two enquiries have been conducted into the cost of "producing" graduates at the University of Bradford in the United Kingdom, one for the academic year 1966-67 and the other for 1969-70. The results are given by discipline in Table 1, columns 2 and 8 respectively. These enquiries were based on a detailed output budgeting of the cost of first degrees; the cost of staff-time devoted to teaching undergraduates, the annual value of the floor space these undergraduates used and so forth, all being identified and costed on an individual discipline basis.[1]

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*We are indebted to Donald Nudds for assistance in overcoming problems of computation.

+The social internal rates of return quoted in table 1 for "All courses" have been published in Economic Trends, No. 211; the rates relating to subject groups ("Technology", "Science", and "Social Sciences") are based on as yet unpublished earnings data obtained from the Department of Education and Science.

[1]For details see: R.K.Khanna and Anthony Bottomley, "Costs and Returns on Graduates of the University of Bradford," Accounting and Business Research, No. 1. (Winter 1970), pp. 56-70 for the 1966-67 figures and J.E.Dunworth, R.K.Khanna, M.Pickford, R.M.Dasey, R.E.Cooley, A.Duggan, C.A.Barton and Anthony Bottomley, Costs and Potential Economies at the University of Bradford (Paris: Centre for Educational Research and Innovation, Organisation for Economic Cooperation and Development, 1972) passim (in English and French), for the 1969-70 figures.

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The results showed that the average cost of producing a first degree graduate in 1966-67 was £2671 in technology, £2961 in science and £1684 in Social Sciences. The overall average of these was £2405. This compares with £2321 at 1966-67 price levels in 1969-70 (see Table 1 columns [2] and [8]). A similar investigation for the whole of England and Wales put the average cost of a first degree net of university research outlays at £2103 in 1966-67.[2]

2. What are the Rates of Return on a University Education and Who Gets Them?

The 1966-67 Bradford outlays per degree granted were compared with the lifetime increments in earning accruing to the holders of nine of the qualifications involved, over and above what they would have earned if they had gone to work with their A-levels only. The resulting internal rates of return (IRRs) on each of these nine degrees are given in Table 1, Column 3. They vary from 5 per cent in Mechanical Engineering to 11 per cent in Statistics. Such are deemed to be society's return on its investment in these categories of university education at Bradford, since the recipient of the extra income arising from the qualification is, himself, a member of that society and is presumed to contribute to it a value equal to his earnings.

Internal rates of return were also calculated on a purely private basis. It was first assumed that the graduate had received a full grant from the State and his parents the appropriate tax remission. The results for him are given in Table 1, column 5. They vary from 19.5 per cent in both Electrical and Mechanical Engineering to 32.5 per cent in Economics. These calculations were done again on the assumption that no grant was available except for fees, and that the consequent private investment per graduate comprised all of the net earnings (net of tax and vacation earnings) which he forewent by not going to work at eighteen (i.e. not their net earnings foregone minus the grant as in the first case). The resulting IRRs are given in Column 6. They vary again,

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[2] Vera Morris and Adrian Ziderman, "The Economic Return on Investment in Higher Education in England and Wales," Economic Trends , No.211 (London: H.M.S.O, May 1971) Table D, p. xxvi

TABLE 1.

Internal Rates of Return Asso
Cost Economies for First D
University of Bradford

COURSE	Average Cost	1966-67 Internal Rates of Return SOCIAL Cornmarket Earnings Data	SOCIAL With Morris-and Ziderman Earnings Data	PRIVATE With Grant	PRIVATE No Grant	GOVT. Tax Receipts	1969-70 Average Cost	1970 Social IRR
	£	%	%	%	%	%	£	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All Courses Average	2405	8.1	8.8	24.9	12.2	5.1	2321	9
TECHNOLOGY	2671						2658	
Chemical Eng.	2350	9.6		25.0	14.0		2189	
Civil Eng.	2265	9.7	8.9	29.0	13.5	4.9	2133	
Elect. Eng.	2875	6.0		19.5	9.5		3102	9.1
Mech. Eng.	3410	5.0		19.5	9.5		3468	
Textile Tech.	2440						2619	(5.2)
SCIENCE	2961						2822	
Pharmacy	2719						2826	
Opthalmic Optic.	3046						2552	
Chemistry	3225	6.5		22.5	10.0		3336	
Col.Chem.	3591						3354	
Mat.Science	3144		7.7			4.0	3217	8.0
Physics	3144	7.5		24.0	12.0		3214	
Biology	3393						3678	
Mathematics	2633	7.5		23.5	12.0		1892	
Statistics	2044	11.0		29.0	15.0		1456	(4.4)
SOCIAL SCIENCES	1684						1482	
Economics etc.	1791	10.0	9.7	32.5	14.0	6.5	1361	9.9
Management	1590						1740	
Appl. Soc. Stu.	1791						1629	(6.8)

* All costs are at 1966-67 prices.

NOTE: Rates of return to the Government in extra taxation receipts are given in paren
are derived from R.K.Khanna and Anthony Bottomley "Costs and Returns on
(Winter, 1970), pp 56-70 and other columns from the data on participation,
"The Economic Return on Investment in Higher Education in England and Wales,"

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TABLE 1.

Internal Rates of Return Associated with Potential Cost Economies for First Degrees at the University of Bradford

GOVT. Tax receipts	1969-70 Average Cost	1970 Social IRR	1981 - 1982 Fall in Staff Costs	Staff Economies Only AVERAGE Cost *	Staff Economies Only AVERAGE Social I.R.R.	Staff Economies Only MARGINAL Cost *	Staff Economies Only MARGINAL Social I.R.R.	Staff and Space Economies AVERAGE Cost *	Staff and Space Economies AVERAGE Social I.R.R.	Staff and Space Economies MARGINAL Cost *	Staff and Space Economies MARGINAL Social I.R.R.	Govt. I.R.R. at the margin (Taxes
%	£	%	%	£	%	£	%	£	%	£	%	%
(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
5.1	2321	9	33	2232	9.3	2046	9.7	1864	10	1330	10.8	8
4.9	2658 2189 2133 3102 3468 2619	9.1 (5.2)	38 29	1972 2005	10 (6.2)	1805 1859	10.3 (6.6)	1615 1682	10.6 (7.1)	1173 1167	11.7	8.7
5.0	2822 2826 2552 3336 3354 3217 3214 3678 1892 1456	8.0 (4.4)	45 48 18 22 41	2591 3005 3056 3066 2327	7.9 (4.3)	2321 2803 2879 2960 2059	8.1 (4.6)	2051 2016 2684 2524 2070	8.6 (5.1)	1160 1241 2248 2031 1605	9.5	6.4
5.5	1482 1361 1740 1629	9.9 (6.8)	22	1277	10.5 (7.7)	1213	10.6 (7.9)	1150	10.7 (8.7)	989	11.1	8.8

are given in parenthesis in columns (9), (12), (14) and (16). Columns (2), (3), (5) and (6)

Returns on Graduates of the University of Bradford," Accounting and Business Research, No.1

articipation, mortality, sex and ability adjustments underlying Vera Morris and Adrian Ziderman

land and Wales," Economic Trends, No. 211 (London: HMSO May 1971) Table D p. xxvi

from 9.5 per cent in both Electrical and Mechanical Engineering to 15 per cent in Statistics.

All of the estimates were made on the basis of the Cornmarket Salary Survey for 1967 which contained earnings by discipline up to the age of forty-five. These earnings had then to be projected for the remainder of the graduates' working lives by means of an extrapolation of the ratio of change between British and American data.[3] Moreover the consequent rates of return did not discriminate between males and females, nor did they take into account activity and mortality rates or what the graduate might have earned without a degree over and above other A-level school leavers as a consequence of his native ability.

Fortunately these ommissions have now been rectified by Morris and Ziderman in their calculation of rates of return for the University system as a whole.[4] They base their estimates on the Department of Education and Science's Survey of Earnings of Qualified Manpower in England and Wales for 1966-67.[5] But the Survey does not break down the data by individual discipline. Moreover Morris and Ziderman did not distinguish the costs of different degrees but simply used the average cost of £2103 per degree granted which was mentioned previously. So it was that the rates of return to society at large which arose from their analysis were given on average as 9.2 per cent with a one third of the difference in earnings between A-level school leavers and university graduates being attributed to ability and therefore not included in the calculation. The Morris-Ziderman social rate of return is somewhat higher on average than for Bradford alone (see the figures in Table 1 column 3) owing to their lower estimate for the cost of degrees, which, when taken with different salary data, more than compensate for the fact that they only took two-thirds of the salary differential attributable to a degree as the benefit.

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[3] See Khanna and Bottomley, op.cit. pp. 67-69

[4] op.cit., Tables D and E p. xxvi.

[5] D.E.S. Statistics of Education, Special Series, No.3 (London H.M.S.O., 1971), Table 6.

We repeated the Morris-Ziderman calculations for male graduates in each of the Bradford subject subdivisions given in Table 1 (1), using their salary data for these divisions with participation, mortality and ability adjustments, and allowing for the different average costs of each degree in technology, science and social sciences. The results are given in Table 1 column 4. They show internal rates of return which vary between 7.7 per cent for science and 9.7 per cent for social sciences with an average of 8.8 per cent overall. Thus the higher average cost of the predominantly technological degrees at Bradford of £2405 as against the Morris-Ziderman average of £2103 reduced average rates of return from their 9.2 per cent to our 8.8 per cent.

Finally, where rates of return are concerned, we calculated the receipts which would accrue to the Government, after ability, participation and mortality adjustments, from taxing the additional income accruing to the male holders of appropriate university degrees at the 30 per cent standard rate which will be effective from April 1973. The resulting direct rates of return to the Government from its outlays on the education of male graduates by categories of discipline plus taxes it forgoes owing to the absence of undergraduates from the labour force while they are at university, are given in Table 1 Column 7.

Such elaborate discussion of rates of return shows how rates of return on university education may vary according to the disciplines involved and/or the cost and revenue assumptions made, as well as to whether the gains are presumed to accrue to society or individuals. It also provides a base from which we may go on to draw rate of return inferences from potential economies of scale.

Morris and Ziderman demonstrated that, under the 1966-67 cost structure in higher education, the sub-university Higher National Certificate (HNC) yielded the highest rate of return on incremental earnings. It was something less than 20 per cent. The HNC with a further qualification conferring membership, or similar status in a professional institute came next (HNC-PQ) with 16 per cent. First

degrees on the other hand, came a poor third with 9.2 per cent, again taking the lifetime earnings of male A-level school leavers as the base and two-thirds of the salary increment accruing to the degree holder as the benefit.[6] The difference in rates of return here were presumably due largely to the fact that the HNC can be gained by part-time study and little or no earnings are foregone.

Outrage rapidly manifested itself in the British university community upon the publication of these conclusions:

> "using wage differentials attached to different qualifications was no correct measure of social returns, university education is an end in itself, it is essential to the maintenance of our culture, civilisation, democratic heritage"

and so on, all of which may be true to some extent. But it did not occur to the critics from the universities to examine their own housekeeping as a possible source of comparatively low economic returns on the nation's investment in themselves, their buildings and their equipment. We now propose to try to make this ommission good.

3. How Might University Costs be Reduced and Rates of Return so Increased?

The results of our research into potential economies of scale at the University of Bradford may be discussed under the headings: (a) staff costs and (b) space costs per degree granted. These issues are dealt with at length in our paper on "Potential Economies of Scale at the University of Bradford" included in this Volume, and we shall treat them only briefly here.

(a) Staff cost economies may be derived from the doubling in the university enrolment envisaged from 1971 to 1981 by the United Kingdom's

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[6] Higher degrees had very low rates of return, but much depends here on cost assumptions. If the graduate students mentioned in footnote 1 as authors of the OECD-DES Report were typical then their marginal costs were probably cancelled by the social value of the work they performed for their degrees. In their case the appropriate IRRs might thus be infinitely high.

Department of Education and Science.[7]

During 1971 an enquiry was made among chairmen or their representatives, of some of the schools of studies at the University of Bradford listed in Table 1 Column 1. They were asked what the maximum number of students in lectures, laboratory classes, seminars and tutorials might reasonably be before, in their opinion, the standard of education would suffer. The doubled enrolment envisaged for 1981 was then fitted into the existing course structures. Teaching costs per student were shown to decline significantly as each type of instruction filled to its maximum student numbers, with new sets of classes being established as and when the postulated limits for each category of class was reached. The results are tabulated in terms of percentage potential reductions in academic staff costs per graduate in Table 1 column 10.[8] The 1969-70 Costs which formed the base for the staff cost percentage reductions were then adjusted for the price level obtaining in 1966-67. The 1969-70 costs at 1966-67 prices are given in column 8. The potential percentage reductions in staff costs with a doubling of enrolment as recorded in column 10 are then used to determine the prospective average total cost per student with these staff economies of scale at 1966-67 prices in column 11. Adaptation to 1966-67 prices was necessary for comparison with the Morris-Ziderman rates of return on other types of higher education for that academic year. New average rates of return for the subject groupings given in Table 1, Column 1 were then calculated again on the basis of the Morris and Ziderman salary data, as against the potential economies of scale in average costs in Column 11, and the results are recorded in Column 12 for the disciplines for which data on potential economies in staff costs were available. The exercise was then repeated for the marginal cost of doubling enrolments and the marginal as opposed to average costs are given in column 13, with the social rate of return on these

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[7] U.K. DES, Student Numbers in Higher Education in England and Wales: Educational Planning Paper No.2 (London: HMSO 1970), paras 5-7.

[8] See also, J.E.Dunworth and R.M.Dasey, "Potential Economies in Academic Staff", Universities Quarterly Vol. 26 No. 2 (Spring 1972), pp. 219-230 and J.E.Dunworth R.K.Khanna et al., op.cit., passim.

marginal costs in column 14.

It is the marginal rates of return such as those reached in Column 14 which are most appropriate as a criterion for social benefit/cost analysis on different types of higher education. With the foregoing assumptions the average cost per degree granted would fall from £2405 in 1966-67 to £2232 in 1981 (at 1966-67 prices) and internal rates of return on average costs would rise from the range of 7.7 per cent to 9.7 per cent to a range of 7.9 per cent and 10.5 per cent (see columns 4 and 12), while the rate of return on the 1981 marginal costs would be higher still at between the 8.1 per cent and 10.6 per cent listed in column 14, assuming of course that the salary differentials between A-level school leavers and university graduates remains the same and that the staff economies of scale inspired by changes in degree costs listed for Bradford are representative of the whole of university education. It should, however, be stressed that the assumptions from which these economies of scale in teaching costs were derived were not prompted by the researchers themselves. They involved no apparent decline in teaching standards or increases in staff-teaching and preparation time. They arose simply out of the relevant academic's opinion regarding maximum size of class for different types of instruction, although it must be admitted that time spent on marking the work of the additional students was not taken into account.

(b) Space costs were examined in terms of laboratory and classroom use at Bradford, again in 1969-70. It was discovered that classrooms were used for only 52 per cent and laboratories for only 41 per cent of a basic thirty-two hour working week of what was, on most courses, a thirty-three week working year.[9] Moreover, the proportion of seats occupied per class session was only some 46 per cent on average.[10]

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9 See J. Dunworth, R.K.Khanna et.al., op.cit., passim.

10 R.E.Dunworth "General Teaching Area Requirements" (University of Bradford, 1972) (mimeographed and in the files of the Registrar).

All this is associated with the fact that the University already has over 100 per cent more general purpose teaching area and over 50 per cent more laboratory area than UGC norms would entitle it to with the present student population. It would, therefore, appear that the postulated doubling of enrolment could be accommodated within the existing university buildings.[11] But we cannot say how true this would be of the British university system as a whole. Further it may be argued that the assumptions regarding the high levels of classroom and laboratory use throughout the working week which we used to make our calculations of space cost savings[12] were overly ambitious. But we would reply that we are not pressing our case nearly as hard as we could do if we allowed for longer working weeks or years and higher levels of seat utilisation, not to mention possible economies of scale in central administrative or library costs and the like.

Moreover, the potential economies of scale which we have identified were more than borne out by a concomittant survey of chairmen of schools of studies, or their representatives, which was also conducted at Bradford in 1971. They were asked to estimate the increased resources which they would require for the average 66 per cent increase in student numbers which they envisaged for the 1972-77 quinquennium. This enquiry too was unaffected by our other calculations of economies of scale, but nevertheless revealed a projected fall in the average cost per student of 31 per cent over the Quinquennium.[13]

Be that as it may, however, if our assumptions regarding classrooms and laboratory utilisation with a doubling of enrolment are accepted, then, allowing for both staff and student economies, the average cost per student for all courses listed in Table 1 at the University of Bradford would fall from the £2405 of 1966-67 to £1864 in 1981-82, a reduction of 23 per cent, while the marginal cost

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11 See John Dunworth and Anthony Bottomley, Potential Economies per Student at the University of Bradford also included in this Volume, passim.

12 Dunworth, Khanna, et.al., op.cit., passim.

13 Dunworth, Khanna, et.al., op.cit., passim.

per student on average would be only £1330.

The rates of return on university education incorporating both staff and space economies might then be expected to rise from between 7.7 per cent and 9.7 per cent, as given in Table 1, column 4, to between 8.6 per cent and 10.7 per cent on average costs or 9.5 per cent and 11.7 per cent on marginal costs as listed in columns 16 and 18 respectively.

CONCLUSIONS

Morris and Ziderman showed rates of return on the sub-university technical qualifications embodied in the HNC and HNC with a professional qualification of > 20 and 16 per cent respectively, against their calculated rate of return for first degrees in England and Wales of only 9.2 per cent. We compared their results with our own using University of Bradford costs and an independent set of incremental salary data. Our results show an average rate of return per degree granted of 8.1 per cent in spite of the fact that we took all of the difference in lifetime earnings between an A-level school leaver and the Cornmarket data with projections on graduate salaries, while Morris and Ziderman adjusted this difference for ability, as well as for graduate labour-force participation and mortality. In this respect therefore, the rates of return on undergraduate education given by Morris and Ziderman may err, if anything, on the side of optimism and our enquiries do seem to support their inference that Higher National Certificates would appear to be a better investment from society's point of view than first degrees. This inference would be clearer still if the analysis had incorporated female graduates as well, whose labour-force participation rates are a good deal lower than for males.

But this does not mean that a rate of return on an investment in undergraduate education of circa 9 per cent is a poor one. After all, it equals the present rate of return on British Government bonds, and this last must surely incorporate, say, a 4 per cent inflationary premium, which the IRR on education does not. This may mean that

the real opportunity cost of capital in Great Britain is less than 5 per cent and that investment in university education is therefore still worthwhile, even if investment in some non-university technical qualifications is even more beneficial. The conclusion is, then, that neither type of investment should necessarily be constrained, particularly if our average rate of return at the margin on educating undergraduates rises to 10.8 per cent (see Column 18 in Table 1) by 1981.

Further, the 2 per cent marginal increment between rates of return on average in 1966-67 and at the margin with a doubling of university enrolment (Table 1, columns 4 and 18) does throw doubt upon the British Governments apparent assumption that the establishment and expansion of Polytechnics, which concentrate on teaching undergraduates at the expense of research, will be more economically advantageous. It is not average costs which should be compared here, but marginal costs, and as far as we know the Government has not made this comparison.

The alert critic may point out that, when we mention social internal rates of return here, we are in fact speaking of a situation in which the British people as a whole provide university education to the relatively few through their payment of taxes and that the extra production represented by increased earnings accrues to the individual holder of a degree, not to society at large. But this is not strictly true. A substantial proportion of the cost of educating an undergraduate is the earnings which he, himself, foregoes while he is studying for his degree. In 1966-67 this averaged £1,451 net as against the average estimated cost to the Government of £2,405 for the degrees listed in Table 1 at Bradford. Therefore, the undergraduate, or his family, does make a substantial proportion of the investment himself if he is not receiving a grant, or would do so without exception if all grants were converted into loans. In these circumstances, the Government would make circa 5 per cent on their investment of £2405 at Bradford, given that 30 per cent of all extra earnings attributable to university education were recovered in taxes.[14] British society at large would, then, have recovered an

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Also assuming that the Government did foregoe 11 per cent of the net earnings which would have been taxable if the undergraduate had gone to work upon leaving school.

annual interest of 5 per cent on its investment in Bradford graduates, which must be close to the national non-inflationary opportunity cost of capital. Society's dividend could rise to 8 per cent in real terms, given the economies of scale outlined for the University of Bradford and unaltered salary differentials (see Table 1, Columns 17 and 19). Thus, the expansion in university education would appear to remain a reasonable social, as well as individual investment, even if there were no cultural and political spillover benefits accruing to it.

UNIVERSITY OF BRADFORD

CORRECTIONS

(1) 10.4 per cent should be substituted for 9.2 per cent on pages 4, 5, 6 and 10.

(2) "more than" should be substituted for " less than" on line 3 from the bottom on page 5.

(3) Read "Society's [tax] dividend" in line 3 of page 12.